233.2.3 Type 1: Median Opening Without Left Turn Lanes

The Type 1 Median Opening has very limited application. Normally, a median opening is not provided for a field entrance or private road, but if an opening is allowed, the Type 1 may be considered. A Type 1 median opening is not normally used for a commercial entrance.

Since the Type 1 does not have a left turn lane, vehicles must slow down in the "passing" lane of the expressway. The potential for a high-speed rear end crash is high. Therefore, these median openings are only considered when the entrance has very low traffic volumes (less than 10 vehicles per day).

Advantages

- Allows for all turning movements at the crossover
- Low cost

Disadvantages

- Vehicles must slow to turning speeds in the passing lane of the expressway
- Because there are no turn lanes, the opening is not easily identified by drivers
- Side-by-side queuing of vehicles within the median (undesirable vehicle placement) often occur
- Vehicles within the median and those vehicles approaching the median can create sight distance restrictions
- 18 conflict points
- Difficult to accommodate the WB-67

Additional Items to Consider

- If large vehicles are expected to routinely use the median opening, accommodations are necessary:
- 84 ft minimum median width

- Off-tracking aprons
- Right-In/Right Out access to the nearest lane is preferred to providing a Type 1 median opening

233.2.4 Type 2: Median Opening with Left Turn Lanes

Rural Expressway, Median Crossovers

Report 2001

Report 2004

Summary 2004

See also:
Innovation Library

The Type 2 Median Opening is the most commonly used. These median openings usually experience safety issues before their capacity is exceeded. Based on crash experience from Missouri and other national studies, when crossroad volumes are less than 1000 vehicles per day (VPD) they typically operate in a satisfactory manner. As volumes on the crossroad approach 2000 VPD, safety issues usually become more pronounced.

This type of median opening may be supplemented with other design strategies (deceleration lanes, acceleration lanes, truck aprons, wide medians, etc.) based on traffic and geometric site conditions.

Advantages

- Allows for all turning movements at the crossover
- Adaptable to a wide range of median widths
- Can retrofit an existing Type 1 median opening without purchasing additional right-of-way.
- Missouri drivers are very familiar with this design
- Medium to low in cost
- Drainage easily addressed

Disadvantages

- Vehicles turning left from the mainline and vehicles using the median opening from the side road can create vehicle placement confusion (ie. who has the right of way)

- Vehicles within the median and those vehicles approaching the median can create sight distance restrictions
- Side-by-side queuing of vehicles within the median (undesirable vehicle placement) can occur
- A designer will not consider including signalized intersections for expressways, although one may be installed at an existing location with the recommendation of the Traffic Division. The Type 2 median opening requires additional geometric improvements before signals can be installed and effectively operated

Additional Items to Consider

- If large vehicles are routinely expected to use the median opening, the following accommodations must be made:
- 84 ft minimum median width
- Off-tracking aprons
- Provide adequate deceleration length for the left turn lanes to minimize the speed reduction required of vehicles in the "passing" lane that intend to use the median opening
- Right turn deceleration lanes may be needed based on traffic volumes. Offsetting the right turn deceleration lane is preferred unless geometric conditions actually decrease the sight distance
- Median acceleration lanes can be used to provide traffic (i.e. trucks) an opportunity to accelerate before attempting to enter the traffic stream. Median acceleration lanes also provide trucks entering the main roadway from the side road a place to accelerate so they do not have to "fit" into a 40 ft. or 60 ft. median.

233.2.5 Type 3: Offset Left Turn Lanes

The Type 3 Median Opening provides offset left turn lanes at expressway median opening to reduce the frequency of right angle and rear end accidents. This applies to expressway intersections with medians wide enough to accommodate the offset turn lanes.

Advantages

- Allows for all turning movements at the crossover
- Serves more left turns than Type 1 or Type 2 Median Openings
- Improves sight distance for mainline left turning traffic
- Reduces the number of high-speed conflicts and the risk of severe crash types (i.e. right angle collisions)
- Improves the angle of view, allowing drivers to more effectively use available gaps
- Separates left turning traffic from the mainline roadway
- Addresses side-by-side queuing by keeping left turning traffic separated from those entering the median from the sideroad
- Less confusion in the median opening, paths are defined more clearly than the Type 1 or 2 Median Opening designs
- Adaptable to a wide range of median widths
- Can retrofit an existing median without purchasing additional right of way and can add a signal without major geometric improvements
- Reduces the number of conflict points

Disadvantages

- Drivers may be unfamiliar with this type of intersection
- Mainline left turning traffic must enter the median sooner than expected
- Possible additional drainage and/or pavement requirements

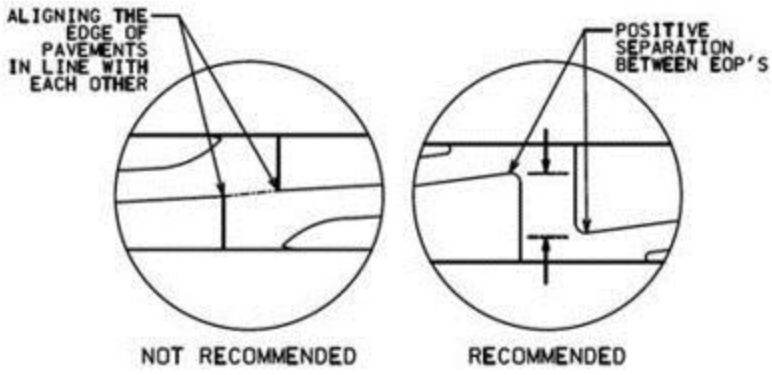
Additional Items to Consider

- Design of offset-left turn lane

- Parallel lane is necessary to provide motorists enough time to react and move into the left turn lane area; 100-200 ft. is an adequate length for the parallel lane

- Storage and deceleration lengths shall be calculated according to each location's traffic characteristics

- It is recommended to provide “positive separation” between the edge of pavements of opposing left turn lanes, as depicted in the drawing below. Having them lined up can, during nighttime, give motorists the false appearance that the lane continues through the median and may lead them to not stop in time.



- Accommodating WB-67 trucks or other large vehicles

- AutoTurn software should be used to simulate the path and off-tracking of WB-67s or other large vehicles that are expected

- 84 ft. minimum width is necessary to allow a truck to fit in the median

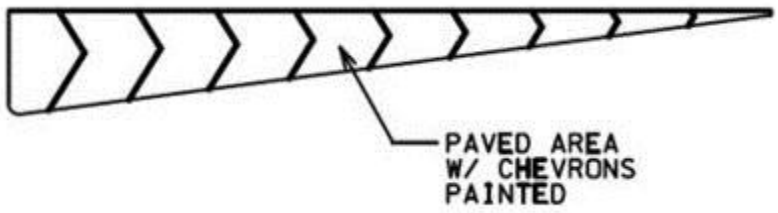
- Provide paved aprons for off-tracking to prevent rutting

- If allowing U-turns, may need to modify sideroad geometrics to make U-turn successful for a WB-67

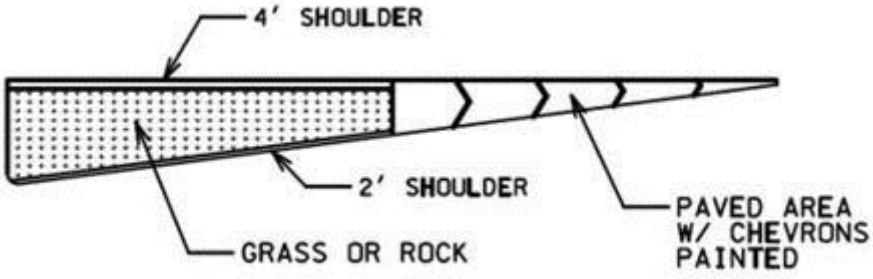
- Median acceleration lanes also provide trucks entering the main roadway from the side road a place to accelerate, so they do not have to “fit” into a 40 ft. or 60 ft. median.

- Recommended options for the triangular area

- Pave entire area and stripe with chevron pattern



- Pave half and stripe with chevron pattern. Grass or rock the rest



- Grass or rock the entire area and include lighting. Without the additional pavement and striping that the other two options offer, there is not adequate delineation at night, so therefore lighting is required.

- Consider giving options in the contract as to how this triangular area could be constructed to promote lower bids

- Signing and striping considerations

- It is important to clearly mark and sign the intersection. Refer to EPG 903.13.25 for signing.

- If the crossroad is a city or county road, it is recommended to install the following left turn lane sign at the beginning of the offset left taper:

It is also recommended to install an advance intersection guide sign, for example:

- Consider using decision sight distance (refer to Exhibit 3-3 in AASHTO's *A Policy on Geometric Design of Highways and Streets 2004*, the "Green Book") as guide for placing advanced intersection guide signs before the left turn opening

- Using painted “shark’s teeth” yield bar at the end of the left turn lane

- Using left turn arrows on the pavement of the offset left turn lane

- Using “dotted” edgeline extensions across the intersections to provide guidance for motorists in the median as to where to stop

- Public information and education programs concerning the operation of offset left-turn lanes and their safety benefits must be considered when these treatments are used for the first time in a given area

233.2.6 Type 4: Directional Median Opening with Downstream U-Turns

Although variations of the directional median opening with downstream median u-turn design have been used in the United States since 1960, this concept is new to Missouri. The Type 4 Median Opening, eliminates some or all traffic movements through the median. Traffic on the sideroad is forced to turn right onto the main roadway rather than go straight through the median. Through and left turn movements from the sideroad are completed through a downstream median u-turn located approximately 600-1000 ft. from the primary intersection. When the median u-turn is located close to the crossroad, the benefit of reducing right angle crashes is limited. Additionally, a close spacing can also force vehicles to make quick weaving movements at speeds slower than those of the through traffic. The specific location of the median U-Turn is determined by a capacity analysis which includes anticipated weaving movements. The Highway Capacity software and VISSIM are useful in this analysis.

Typical signing details are found in Figure 903.13.26 Typical Signing for Type 4 Median Openings and in Figure 903.13.27 Signing for Type 4 Right-In, Right-Out Openings.

Michigan, Florida, Maryland, and North Carolina currently use geometric designs that restrict some or all turning movements at the primary intersection and provide for downstream u-turns. These treatments are primarily used in

urban rather than rural areas in Michigan and Florida. Also, the "Michigan U-Turn" is usually signalized with the secondary through movements using the normal intersection path.

Advantages

- Reduces crash potential, especially for high severity right angle crashes (conflicts points are reduced to 4). Left and through movements from the sideroad are completed by a two-stage merging movement as opposed to a one stage crossing movement.
- Can accommodate approximately two-times the sideroad volume as compared to the traditional (i.e. Type 2) median crossover type. Typically, it operates effectively for sideroad volumes up to 2,000 VPD and can function for volumes up to 4,000 VPD, depending on site-specific conditions.
- May be easily retrofitted from a Type 1 and Type 2 median opening (depending on site conditions) without purchasing additional right-of-way.
- Low to medium cost
- A designer is not to consider including signalized intersections for expressways, although one may be installed at an existing location with the recommendation of the Traffic Division. This type of median opening can efficiently be retrofitted with traffic signals.

Disadvantages

- Most drivers (including typical Missouri drivers) are not familiar with this design
- Requires extraordinary signing and public education efforts
- Creates adverse travel; some movements are indirect
- Creates mainline weaving movements

Additional Items to Consider

- Not to be used with median widths less than 60 ft.
- This median opening is a flexible design and may be supplemented with other design strategies (acceleration/deceleration lanes, wide medians,

etc.) based on site-specific traffic and geometric conditions. For instance, median acceleration lanes can be used to provide traffic (i.e. trucks) an opportunity to accelerate before attempting to enter the main roadway traffic stream.

233.2.7 Type 5: Partial Grade Separated Intersection

A Type 5 Median Opening, or Partial Grade Separated Intersection, is considered a hybrid of two common types of median openings]; the traditional diamond interchange for one direction of traffic, and a Type 2 median opening with median acceleration/deceleration lanes for the opposing direction of traffic. Since this type of median opening is essentially an interchange involving construction of a bridge structure, providing it at a rural expressway location must be only considered when less costly alternatives have been exhausted as the result of safety concerns and capacity issues. This type of median opening can be used as a low cost alternative for a “trumpet” style interchange.

This type of median crossing is used to eliminate the frequency of collisions between left turning and opposing through vehicles, as well as rear-end crashes of vehicles traveling in the same direction. This crossing can be used for any expressway intersection but is best suited to “T” type intersections where the crossroad traffic volumes exceed what is considered acceptable for traditional “at-grade” intersections.

Advantages

- Allows for all turning movements at the crossover
- Minimizes potential for severe right angle crashes
- Provides a wider median for long vehicles, such tractor-trailer trucks
- Separates left turning traffic from the mainline roadway
- Has less right-of-way impact than a full diamond or trumpet interchange
- Cost is significantly less than a traditional diamond interchange
- A blend of two familiar configurations satisfies driver expectation

- Could retrofit an existing median crossing without purchasing additional right-of-way, if existing terrain is acceptable (i.e.: profile of one lane is higher than other)

Disadvantages

- Cost – bridge structure, additional grading, pavement, and right-of-way
- Right-of-way impacts are higher than with an at-grade intersection
- On straight alignments a median flare is required to accommodate the grade separation; thus introducing horizontal curvature
- The possibility of additional drainage requirements near the bridge

Additional Items to Consider

Public information and education programs must be considered concerning the operation of the Type 5 median opening including the resultant safety benefits when this treatment is used for the first time in an area

Additional signage is necessary to avoid driver confusion and thus prevent the motorist from entering the wrong roadway against opposing traffic, especially on the at-grade intersection side

Develop detailed guidelines and parameters for use and application

Instruct designers on the proper application of this type if intersection

If a median opening is to be constructed of portland cement concrete, the plans will show the joint layout. To avoid sympathy cracks in the travelway, it is desirable to match median opening joints with the adjacent travelway joints and avoid specifying a median opening joint that will intersect the adjacent travelway where no joint exists. It is acceptable for joints in the centerline of the median opening not to match directly. Additional information concerning pavement joints can be found in the Pavement article.